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# THE PALEONTOLOGY OF THE CRETACEOUS FORMATIONS OF TEXAS.

## THE INVERTEBRATE FOSSILS OF THE CAPRINA LIMESTONE BEDS.

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Contents.



### I.—Stratigraphic Position of the Caprina Limestone Beds in the Comanche Series.

About midway in the column composing the Comanche series or Lower Cretaceous of Texas, and constituting the uppermost member of the Fredericksburg division (Comanche Peak group of Shumard in part), there is a peculiar group of strata known as the Caprina limestone of Shumard.*

Dr. Shumard placed the bed in the Upper Cretaceous, at the very top of the whole of the fifteen or more subdivisions of the

* First Annual Report Texas State Geological Survey, Austin, 1880–'88, pp. 124–126.

two great formations of Texas, instead of in the middle of the lower series, where it belongs. His original description of it is as follows:

*Caprina Limestone.*—This is the uppermost recognized member of the series and, although of no great thickness, has a somewhat extended geographical range. It is a yellowish-white limestone, sometimes of a finely granular texture and sometimes made up of rather coarse, subcrystalline grains, cemented with a chalky paste. It generally occurs in thick massive beds, and is capable of withstanding the action of the weather to a greater extent than most of the members of the Cretaceous system. This formation is usually found capping the highest elevations, and its presence may be nearly always recognized, even at a distance, by the peculiar flat-topped and castellated appearance it imparts to the hills. According to Dr. Riddell, it is finely displayed along the bluffs of Brazos river in Bosque, McLennan, and Hill counties; also along the Leon and Bosque rivers. The summits of the remarkable elevation known as Comanche peak, in Johnson county, and that of Shovel mountain, in Burnet county, consist of this rock. The fossils are chiefly Caprina, Cytherea, and Ammonites of undetermined species. (Trans. St. Louis Acad. Science, vol. I, 1860, pp. 583-584.)

In a previous paper the writer has described the Caprina limestone substantially as follows:

*The Caprina Limestone.*—Without any serious stratigraphic break in the chalky limestones the abundant Comanche Peak fauna disappears and there continue 300 feet, more or less, of chalks and chalky limestones of varying degrees of consistency, from a pulverulent condition to firm limestones, which seem to be a secondary condition of the chalk produced by superficial hardening. These hard layers form the table rock of the buttes and mesas of the extensive Grand Prairie region and are exposed in the river bluffs between Austin and Mount Bonnell, on the Colorado, where the chalk has been more or less hardened into firm limestones by the local metamorphism accompanying faulting. The lime-kilns and quarries immediately west of Austin are all located on this subdivision.

Accompanying these chalks and chalky limestones are well defined layers of exquisite flint nodules, occupying apparently persistent horizons in localities. The flint nodules are oval and kidney-shaped, ranging in size from that of a walnut to about two feet in diameter. Exteriorly they are chalky white, resembling in general character the flint nodules of the English chalk cliffs. Interiorly they are of various shades of color, from light opalescent to black, sometimes showing a banded structure. These flint nodules are beautifully displayed *in situ* in the Deep Eddy canyon of the Colorado, above Austin, where they can be seen occupying three distinct belts in the white chalky limestones.

Where these chalky limestones form the basis of extensive plateaus, such as the remnants of the Grand Prairie west and southwest of Austin,

the flints are left in great quantities as a residuum of the softer chalks (which are more readily decomposed into soils and washed away), and they cover large areas of country. They have also been transported eastward in past geologic times by marine and river action, and are distributed over large areas along the margin of the Black Prairie region as a part of the Post-Cretaceous gravels of that region. In some of these flints remarkable decomposition is exhibited, the products being geode-like cavities lined with quartz-crystals and pulverulent substance.

These are the only flint horizons, so far, at least, as is known to the writer, in the whole of the immense Cretaceous deposits of the United States. They occur about the middle of the Lower Cretaceous series instead of at the top of the Upper series, as in England. It was from these flints that the ancient and modern Indians made their flint implements, and the ease of their lithologic identity will be of value to the anthropologist in tracing the extent of the intercourse and depredations of former Indian tribes inhabiting this region. Occasionally the flints, especially an opalescent variety in Comanche county, possess nuclei in the shape of fossils, usually *Requienia*.

The decomposition of these flints and of the adjacent limestones has produced some peculiar and unique effects in the rocks and landscape of the region, the silica replacing the calcium carbonate and leaving as a remnant a peculiar porous cavernous rock, usually of a deep-red color from the hydration of the iron pyrites into limonite, composed of the siliceous pseudomorphs of fossil *Rudistes* and other shells, the interstitial spaces glittering with minute quartz crystals which line them.

Immediately west of Austin, along the downthrow of the great Bonnell fault in the bluffs of the Colorado, another peculiar transformation takes place in the Caprina limestone. Occasional red decomposing spots occur in the massive white chalky limestones. Upon closer examination the apparently non-fossiliferous limestone is seen to be undergoing decomposition into a dry pulverulent inflorescence, and as a residuum there remains a dry red dust containing exquisitely preserved calcite pseudomorphs of many rare fossils, such as recently described by Roemer and White, the occurrence of which I have located in this horizon.

Traces of the following economic products have been discovered: Potash, salt, strontianite, anhydrite, epsom salts, gypsum, and gold, but in quantities as yet unknown.

At Austin a fault of about 750 feet downthrow has broken this limestone division into two different areas, and hitherto confused its measurement.

The limestones are more resistant to erosion than the over and under lying strata, and hence form the summit scarps and mesas of the peculiar buttes and divides in Hood, Comanche, Hamilton, Bosque, Coryell, Lampasas, and other counties of the Grand Prairie regions of Central Texas. It also occurs as the surface of extensive prairie regions in western Williamson county. It also caps the summit of the Jehosaphat plateau in

northwestern Travis county, and the Edwards plateau to the south, where its surface outcrops, owing to rain sculpture, is weathered into extensive fields of "Karrenfelder" or miniature mountains.

The limitations of this group of strata have not been finally determined, but it should include as its upper members the Austin marble (the Upper Caprotina limestone and the lithographic flags of my local Austin section). No abrupt break is evident between these and the underlying beds which contain the Comanche Peak fauna of Shumard (Die Kriedebildungen bei Fredericksburg of Roemer). The detail of these beds at Austin have been given by Mr. J. A. Taff (who made the section under my supervision) in the Third Annual Report of the Texas Geological Survey.

Stratigraphically the Caprina limestone represents the culmination of the subsidence that progressed during the Comanche epoch.

Paleontologically the Caprina limestone beds are of the greatest interest, for in them we have the development of the aberrant *Chamidæ* and *Rudistes* of this country. They contain all the species of these families known to occur in the Cretaceous of the United States, with the two exceptions of the Caprotina-like *Coralliochama* of California and the large *Radiolites austinensis*-like forms so common in the equivalents of the Colorado group of the Upper Cretaceous in the Alabama, Texas, and Colorado regions. As it is clearly and distinctly overlain by the whole of the Washita division which corresponds to the Gault of Europe, as will be later shown by the writer, and is above the well-defined beds of the Trinity and Lower Fredericksburg division, it affords an important landmark in tracing the progress of marine life on this side of the ocean.

## II.—Characteristic Fossils.

The fauna of the Caprina limestone has been little understood, owing to the unfortunate fact that many of its fossils have been attributed to other horizons. Shumard* included the Lower Caprotina limestone of the Trinity division in Hood county with the Caprotina limestone of the Caprina beds, and throughout his valuable literature one fails to find any distinction between them. A few years since my friend, Mr. George Stolley,

* Loc. cit., p. 584.

discovered a fauna in what is now known to be the Caprina limestone in the bluffs of the Colorado, a few miles west of Austin. Not knowing the horizon of these beds, he sent them to Dr. C. A. White, of the United States Geological Survey, and Dr. Ferdinand Roemer, at Breslau. Dr. White described several of the forms of aberrant *Chamidæ*, but owing to the lack of stratigraphic particulars he refrained from publishing any age conclusions.* Dr. Roemer published † beautiful illustrations of these fossils and described them with his accustomed skill, but at that time, not knowing the comprehensive character of the beds in the immediate vicinity of Austin and probably deceived by the lithologic resemblance of the matrix, he erroneously concluded that they came from the Austin chalk (Niobrara) of the Upper Cretaceous. His conclusions that the Austin chalk from which he supposed these fossils to have come was of Turonien age was undoubtedly correct. The Austin chalk abounds in many other species which justify such a conclusion, but not one of these species later described warranted such a conclusion, nor did they come from that horizon. The writer regrets that he is unable here to republish Dr. Roemer's excellent figures and descriptions of this fauna.

The following is a list of the species which I have observed from the Rudistes horizon in the Caprina limestone beds at Austin, Texas:

*Parasmilia austinensis* Roemer.
*Pleurocora texana* Roemer.
*Pleurocora coalescens* Roemer.
*Cladophyllia furcifera* Roemer.
*Coelosmilia americana* Roemer.
*Holectypus* Roemer.
*Patella* or *Pileolus* (?).
*Chrysostoma.*
*Helicocryptus* or *Adcorbis.*
*Ziziphinus* (*Calliostoma*).
*Nerinea austinensis* Roemer.
*Nerinea cultrispira* Roemer.

* Bulletin 4, U. S. Geological Survey, on Mesozoic fossils, by C. A. White, Washington, 1884.

† Paleontologische Abhandlungen Herausgegeben von W. Dames und E. Kayser, Vierter Band. Heft 4. Ueber eine Durch die Haeufigkeit Hippuriten-Artiger Chamiden Ausgezeichnete Fauna der Oberturonen Kreide von Texas von Ferdinand Roemer. Mit 3 Tafeln. Berlin, 1888.

*Nerinea subula* Roemer.
*Glauconia* (?).
*Cerithium obliterato-granosum* Roemer.
*Cerithium austinensis* Roemer.
*Trochus texanus* Roemer.
*Solarium planorbis* Roemer.
*Natica* (*Amauropsis*) *avellana* Roemer.
*Requienia patagiata* Ch. A. White.
*Monopleura marcida* Ch. A. White.
*Monopleura pinguiscula* Ch. A. White.
*Lucina acute-lineolata* Roemer.
*Requienia patagiata* Ch. A. White.

The following forms have a more general occurrence:

*Ostrea munsoni* sp. nov.
*Radiolites texana* Roemer.
" *davidsoni* sp. nov.
*Requienia texana* Roemer.
*Ichthyosarcolithes anguis* Roemer.
*Monopleura marcida* Ch. A. White.
*Ammonites* (*Buchiceras*) *pedernalis* von Buch.
" (*Schloenbachia*) *acute-carniatas* von Buch.

In addition to the foregoing numerous species have been described under the generic name of *Caprina*, owing to the occurrence in immense quantities of a fossil supposed to have belonged to that genus. These fossils, however, are usually imperfectly preserved, but it can now be said with assurance that none of them belong to that genus, but are mostly *Ichthyosarcolithes* or *Radiolites*. All of the so-called Caprinas heretofore described from Texas come from this horizon.

Most of the Austin species occur in the bluffs of the south bank of the Colorado and Barton creek, just west of Austin, as beautifully preserved calcite pseudomorphs. Usually the limestone is very barren of all fossils except the *Rudistes* and *Chamidæ*.

Other aberrant *Chamidæ* and *Rudistes* from the Texas Cretaceous have long been known, but their exact stratigraphic range has not been clearly stated. With the exception of *Radiolites davidsoni* herein described, the stratigraphic occurrence of all the species was unknown to their authors when they described them. Many were described from imperfect specimens, and all the writers previous to Dr. White's valuable contribution expressed

serious doubts as to the true generic position of the forms. It can now be said that, with the single exception of *Radiolites austinensis*, all of these forms in Texas come from the Caprina limestone. The following is a list of the forms thus far described:

CHAMIDÆ.

*Diceras* (*?*) Roemer.
*Requienia bicornis* Meek, 1876. Fort Lancaster, Texas.
" *patagiata* White, 1884. Near Austin, Texas.
" *texana* Roem., 1852; White, 1884. Near Austin, Texas. Highlands between New Braunfels and Fredericksburg. Marcou, 1858, reports this form at "Comet creek, on left bank of the False Washita."
*Monopleura marcida* White, 1884. Near Austin, Texas.
" *subtriquetra* Roem., 1852. Valley of San Saba and upper arm of Pedernales river.
" *pingiuscula* White, 1884. Near Austin, Texas.
" *texana* Roem., 1852.
*Ichthyosarcolithes anguis* Roem., 1888, Barton creek, west of Austin.
" (*?*) (*Caprina*) *crassifibra* Roem., 1849, 1852.
" (*?*) (*Caprina*) *guadalupæ* Roem., 1849, 1852.
" (*?*) (*Caprina*) *planata* Con., 1855. Oak creek, near Pecos, Texas.
" (*?*) (*Caprina*) *occidentalis* Con., 1855, 1857. Pecos river near mouth. (A. Schott.)
" (?) (*Caprina*) *texana* Roem., 1849.
*Plagioptychus* (*?*) *cordatus* Roem., 1888.

RUDISTÆ.

*Radiolites* (*Hippurites*) *texanus* Roem., 1849, 1852.
" *davidsoni* sp. nov.

All of the above species occur in the Caprina limestone. *Radiolites austinensis* Roemer, is the only other form from the Texas Cretaceous. It occurs in the Austin chalk, and is so radically different in every aspect that it hardly belongs in the same group with the lower forms. With the exception of *Monopleura* and *Requienia*, which range downward into the Trinity Division, all the other genera occur only in the Caprina limestone, appearing suddenly upon the scene with these beds and completely vanishing thereafter.

*Radiolites texanus* Roemer, which comes from the Caprina

limestone, was referred to the genus Hippurites by Roemer,* although upon reading his description as originally published it will be seen that he distinctly stated that it was exceedingly doubtful whether this form belonged to *Radiolites* or *Hippurites*. The name *Hippurites*, however, has gone forth in literature, and, inasmuch as this genus is a characteristic form of the Upper Cretaceous of Europe, its supposed occurrence in the Lower Cretaceous of Texas has been the greatest obstacle to man in accepting the lower position of the Comanche Series. I am now prepared to state that there is not a single *Hippurites*† in either the Lower or Upper Cretaceous of Texas, and that this unfortunate impression should no longer prevail.

## III.—Age of the Caprina Limestone.

The writer does not feel prepared to separate the Caprina limestone from the remainder of the Fredericksburg Division as a unit for the discussion of homotaxy, and in the following remarks it should be remembered that the beds are stratigraphically related.

Dr. Fred. Roemer, in his classical monograph of the Kreidebildungen von Texas, placed the beds which are now known to be the Caprina limestone at the very top of the Texas Cretaceous and referred them to the Senonien. Forty years later he unknowingly described more of the fauna from the same beds and placed them in the Turonien.‡ In earlier writings I § have shown the erroneous impression under which Dr. Roemer thus placed these beds, and that instead of occurring above his Turonien (Austin chalk beds) they are stratigraphically below them, and hence could not be Senonien.

Shumard, who first defined and applied the present name to the beds whose fossils had been described in part by Roemer, also failed to discover the true stratigraphic position, and likewise placed them at the top of the Texas Cretaceous.‖

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* Kreide, von Texas, p. 76.

† In the Third Annual Report of the Texas Geological Survey a species is mentioned by name only as "*Hippurites flabellata* sp. nov." from the Caprina limestone. No description whatever has been given of this form. From the writer's familiarity with the specimens in the Texas collection he thinks it probable that it must be a Radiolites.

‡ Paleontologische abhandlungen.

§ Am. Journ. Sci., vol. xxxvii, 1889, pp. 318–319. Ibid, April, 1893.

‖ Loc. cit.

The writer has repeatedly shown that the stratigraphic position of the beds was in the middle of the Lower Cretaceous or Comanche series instead of at the top of the Upper, as believed by Roemer and Shumard, and hence, aside from the paleontologic evidence, he would assign these beds to a still lower horizon, probably the Uppermost Neocomian, or Transitional Neocomian-Gault, for the following reasons:

1. The fauna does not contain a single characteristic genus or species of beds of higher position.

2. The beds occur immediately beneath the Washita Division, which contain numerous species resembling those of the Gault of Europe.

3. The beds bear a remarkable paleontologic and stratigraphic resemblance to the Requienia Limestone beds of France and the Spanish Peninsula, where similar limestones, with *Radiolites* and *Requienia*, abound in the Upper Neocomian.

## IV.—Description of Species.

**Ostrea munsoni** sp. nov.

Plate XII.

Compare *O. Joanæ* Choffat. Recueil de Monographies Stratigraphiques Sur le Système Crétacique du Portugal, par Paul Choffat. Lisbon, 1885, p. 34, plate 1, figs. 1-7.

Very thin and flat; elongately sub-triangulate and marked by many well defined radiating ribs; the pallial extremity rounded; beak more or less acuminate and slightly deflected, and evidently slightly attached; the inferior valve slightly concave, nearly flat, and showing near its beak an area of attachment. The larger valve flatly convexed and only slightly larger than the lower; the ornamentation of both valves is similar, and as remarked by Choffat in his description of *Ostrea Joanæ* a very similar form from Portugal, the two valves present an appearance as if they had been plicated together, the one upon the other. Each shell is very thin, and the living space small. When closed together the thickness of both valves is hardly one-twentieth the length of the shell.

The finely fluted ribs are slightly sinuous, continuous from beak to base or sometimes bifurcated, alternating with short ribs extending only half way from base. This is especially true upon the lower valve. This species is easily distinguishable from all the other North American oysters by its extreme flatness and thinness.

I have observed only a few specimens. These occur with great scarcity in the Caprina limestone, in association with *Radiolites davidsoni* at Belton and near Austin. The species is named in honor of Mr. T. V. Munson, of Denison, Texas.

This species resembles in general form the excellent figures of *O. Joana* Choffat, from the Cretaceous of Portugal.

**Radiolites davidsoni** sp. nov.

Plate XIII.

*Description of Figured Specimen.*—Very elongate, measuring over 40 centimeters; slightly flaring at larger end and gently tapering to small extremity; somewhat sinuous, pointed, and attached at lower end; exterior surface strongly marked by longitudinal ribs and grooves, as follows: Two especially broad and conspicuous grooves extending the entire length of the shell on opposite side to that shown in large figure, but seen in small segment and end view. These are accompanied by two large corresponding oblate ribs and a sharp, angular carina. These two grooves, ribs, and carina occupy one of the sides of the subtriangular circumference. The carina is very prominent and sharp, and extends from the smaller end to within about ten centimeters of the large extremity, where it becomes exfoliated and deflected like a mantle over and across the large ribs and grooves. This carina forms the upper margin of the large figure, and the angles seen in the cross-sections, and is opposite the smaller angle of the semi-lunate interior. It is bordered upon one side by one of the major grooves above described and upon the other by the somewhat flattened face shown in the figure of larger cross-section, on Plate XIII. The remaining two-thirds of the surface of the shell is marked by about fifteen small linear ribs, separated by wide, slightly concave depressions. Interior of shell a hollow cavity subpyriform or semilunate in cross-section, and marked by a few widely separated concave partitions occurring at intervals of three to five centimeters. Opposite the left hand major groove there is a slight projection extending the length of the interior which makes a narrow sinus in the casts when found. The interior is usually filled with calcite crystals.

Shell, irregularly thick, varying from three-quarters to one-half centimeter in different parts of the circumference. Outer surface is very smooth between the flutings and marked by fine

cross-striæ, which are the exterior terminals of the circumscribant septæ of the honeycombed structure. The shell is composed of two layers (see fig. 1). The outer one (*a*) is very thick and constitutes most of the substance and has a fine cellular honeycombed structure. Cells very minute and rectangular in cross-section and produced by the intersection of the concentric and vertical laminæ. The imbricate concentric laminæ are arranged in successive layers diverging upward from the interior layer of the shell. The interior shell (*b*) is thin and very poorly preserved, being largely replaced by calcite crystals.

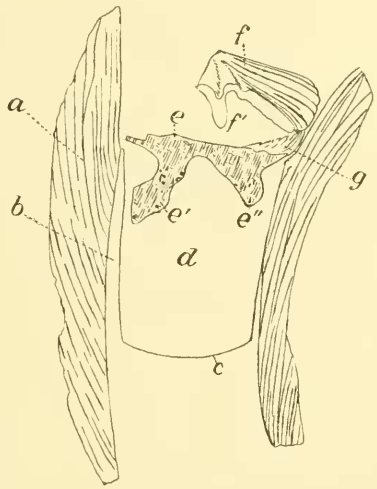


FIG. 1.—*Longitudinal section of larger extremity of specimen figured on plate xiii.*

*a*, outer shell of larger valve; *b*, space once occupied by inner shell of same; *c*, a cross-septum of interior cavity; *d*, last chamber of interior cavity; *e' e''*, calcified area, marking position of the muscular apophysis of upper valve; *f*, small fragment of upper valve; *f'*, section of outer edge of apophysis; *g*, undetermined fragment.

The opening of the shell is composed of the thin interior shell and a few layers of the exterior shell. Most of the concentric laminæ of the latter gradually disappear before reaching this termination. The dwelling chamber is about one and one-half centimeters deep, and the details of its structure somewhat concealed by the filled-in matrix. A longitudinal section of the large extremity (fig. 1) gives no detail of the anatomy of the living chamber, but gives some light on the upper valve.

*Upper Valve.*—No satisfactory specimen of the smaller valve has been found. In the specimen figured on plate XIII and in accompanying figure at *f* there is a fragment preserved, superficially resembling the shell of a Pecten, which, however, upon careful inspection appears to be a broken remnant of the smaller upper valve. It is composed of strongly radiating ribs alternating with finer lines, and in the longitudinal section shows a well-defined apophysis (*f*) corresponding to one of the casts preserved in the larger valve (*e''*). The section also shows distinctly the casts of the two muscular apophyses (*e' e''*) of the small valve, as in Radiolites.

The generic position of this form has been perplexing, and possibly it deserves a distinct generic position. That it is nearer *Radiolites* than *Hippurites* is clearly shown by the absence of many of the characteristic features of the latter genus, such as the numerous partitions which cross the interior cavity; the different structure of the dwelling-chamber, and the presence of only two instead of three longitudinal sutures. Upon the other hand, it possesses many of the distinguishing characteristics of *Radiolites*, such as the prominence of the two well-defined longitudinal sutures and the structure of the interior cavity. It also differs from the genus *Sphærulites*, which is characterized by one longitudinal suture. The cells are mostly rectangular, while of the genus *Radiolites*, according to Zittel, there are five or more sided. This distinction has been used by some writers to make new genera, but the writer prefers to defer such action.

The form occurs in great abundance in the limestones near the water's edge of the Lampasas and Leon creeks, in the eastern suburbs of Belton, Texas, from whence the type specimens were collected by Professor Wilson T. Davidson, in whose honor it is named. It is also abundant near Round Rock and Austin. There is a possibility that this species may be the same as the form entitled "*Hippurites texanus*" of Roemer, figured and described in Die Kriedebildungen von Texas, of Roemer; but however strong the inclination may be to think they are the same, his descriptions and figures are so radically different that they cannot be said to be identical.

*H. texanus*, as figured, shows the cells to be polyginal instead of rhomboidal, as in *R. davidsoni*, and the surface grooving and cross-sections are entirely different in detail.

*R. davidsoni* shows great variation in length, some of the forms being very stunted and much thicker than the specimen figured.